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ABSTRACT

A study was conducted to determine if a relationship exists between cognitive styles and learning performance. Seventy students enrolled in three sections of an introductory instructional media course at a southeastern university served as subjects for the study. Testing instruments were administered to the students to determine their cognitive styles. Measurement of the students' learning performance consisted of four major course requirements: graphic production skills (SKILLS), a recall type examination (FINAL), a problem solving activity related to selection and evaluation (PRACTICUM), and the development and implementation of a mediated teaching module (PROJECT). For the SKILLS variable, field independence emerged as the strongest predictor of learning performance. The FINAL variable produced some strong, albeit confusing predictors. For the PRACTICUM variable, positive influences of qualitative code auditory, the cultural determinant individual, and the deductive reasoning variable all predicted learning performance. For the PROJECT variable, positive influences of field independence, individuality, and kinesics were the strongest predictors of learning performance. (Author/LLS)

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COGNITIVE STYLE PREDICTORS OF PERFORMANCE

The application of the trait-treatment research methodology to instructional design procedures has been operationalized by the matching model of instruction. This approach seeks to link specific treatment components to functional characteristics of learners in order to correct or compensate for deficiencies, capitalize on strengths, or challenge the learner (Messick, 1974). While a large body of literature supports the validity of such an approach, results to date hve been inconsistent. Matching students and teachers based on similarities in their cognitive styles (McAdam, 1971) produced increases in educational development and reading level, with "matched" students expressing a more positive attitudes about their instructional activities than unmatched students. In another community college study, Frever (1975) successfully matched students with educational activities, resulting in higher course grades. On the other hand, Scerba's (1977) matching of learning styles with teaching styles produced no differences on any measure of student performance. Considering the difficulty and expense of matching students with teachers or preferred instructional activities, a strong rejection of matching procedures was suggested.

The efficacy of the matching model of instruction is partially predicated on establishing consistent relationships between cognitive and learning styles (traits) with achievement variables. Consistent with principles of aptitude-treatment interaction research, the temptation to generate generalizations about the predictive validity of cognitive styles must be resisted (Cronbach and Snow, 1977). The most extensively researched style, field dependence-independence, has failed to show any such relation to overall achievement measures anyway (Witkin, et al., 1977). Further, the potentiality of cognitive style variables as predictors of academic performance is overshadowed by firmly esablished relationships with mental ability (intellegence), level of motivation, and prior learning

(cognitive structure). While traits measured by cognitive styles such as field dependence and conceptual style are independent of intellegence (Frehner, 1972), their relative contributions to variance on school performance measures are small when compared to I.Q. scores (Robinson and Gray, 1974). This study sought to determine the predictive relationships between several cognitive styles and different types of academic performance. While intellegence scores were unavailable and therefore not accounted for, intellegence seemed to emerge in the form of a stong factor generated by the analysis of data.

Cognitive Style Predictors

The present study considered the potential predictive contributions of several cognitive styles: field articulation, locus of control, and the educational cognitive styles as conceived by the Hill model. The latter consists of twenty-eight variables descibing the means by which individuals derive meaning from the environment - symbolically, culturally, and inferentially.

The research base is best established for field dependence-independence, the perceptual and intellectual skill of extracting information from its surroundi field. Field independent subjects are not as affected by contextual information, are better able to impose their own structure on information and are generally less socially interactive. Field independence is highly correlated to mathematical skills and a predilection for math/science instruction (Feij, 1976), concept learning (Rains and Meinke, 1976) and problem solving ability (Witkin, et al., 1977).

The educational cognitive styles were developed by Hill (1974) as part of the educational sciences, with the expressed purpose of guiding instructional decisions with regard to the styles of learners. If instruction were adjusted to fit students' educational cognitive styles, then mastery learning by almost all stuents would be possible. The potential of Hill's model remains questionable, due to lack of a consistent

predictive relationship between style variables and academic performance. Mustachio (1977) found only a minor, post hoc relationship to achievement. Educational cognitive styles did not aid the teaching of disadvantaged (Berke, 1976), and only moderate concurrent validity was found between styles and achievement in lower class students (London, 1975). In a large community college and university study, the American College Testing Program (1977) mapped students and individualized programs to accommodate styles, finding no significant relationships between educational cognitive styles and learning outcomes. The future of these cognitive style variables in addition to the matching model of learning is predicated on establishing consistent relationships between cognitive styles and various types of performance. Without such support, these constructs will devolve into obscurity like so many other educational panaceas.

Method

A total of 70 students were enrolled in 3 sections of an introductory instructional media course at a southeastern university. The sample included upper level under raduate and graduate students completing degrees in a variety of majors. It should be noted that the sample was predominately female. Because of attrition and record keeping problems, complete data were available for only 56 students. During the initial class session, students were administered a selection of personality and cognitive style instruments.

Instrumentation

Rotter's Internal-External Scale (Rotter, 1966) is a 29-item (six fillers), forced-choice test which assesses degree of internnality or externality. Respondents are expected to choose between two statements which they generally feel or believe is true. Larger scores represent higher levels of externality.

The Hidden Figures Test (French, Ekstrom, ad Price, 1963)

measures field articulation. It is designed to test an individual's ability to locate simple, irregular figures embedded in more complex stimulus patterns. It has been correlated (r=.63) with Witkin's Embedded Figures Test (Jackson, Messick and Myers, 1964). It consists of 32 complex black-and-white, geometric figures. Subjects are instructed to identify, in multiple-choice fashion, which of five simple figures are hidden in each complex stimulus item.

Educational Cognitive Style Inventory is the test battery developed at Oakland Community College (Michigan) to determine the educational cognitive style of individuals. As a part of the Eductional Sciences (Hill, 1974), this instrument seeks to empirically map an individual's mode of behavior in searching for meaning. An individual's eductional cognitive style is comprised of the Cartesian product of sets of information: symbols and their meaning, cultural determinants of the meaning of symbols, modalities of inference, and educational memory. The first three of these are measured by the Cognitive Style Interest Inventory; the last remains in the developmental stage.

Twenty-eight variables (see Table 1), each consisting of eight items in the inventory, are measured. These are forced-choice responses (rarely, sometimes or usually) to questions related to each style measured. Each response is weighted and summed for each variable. The ordering of questions is randomized to minimize response set.

Insert Table 1 about here

The independence of each of these variables has been questioned by Clark and Sheriff (1977). In conducting a factor analysis, they found a single major factor (eigenvalue= 8.0) and three other significant factors onto which the majority of variables loaded. A similar analysis, conducted as part of this study, indicated that all 28 variables were not in fact independent.

The dependent variables consisted of four major course

requirements. Graphic production skills (SKILLS) comprised the total point score from the qualitative evaluation of several instructional materials produced by students such as transparencies, filmstrips, slides, and other graphics, adjusted for the number of attempts necessary to reach a predetermined criterion score. Performance required a combination of psychomotor ability, esthetic evaluation, artistic ability, and so on. The second variable was a recall type examination (FINAL) consisting of fifty objective questions measuring recall of facts, procedures, rules, and principles. The third measure consisted of a problem-solving activity (PRACTICUM) related to selection and evaluation, wherein students were required to select media appropriate to given instructional situations and rationalize their choices using principles of instruction and media utilization. Analysis and synthesis skills were involved in this task. The final variable consisted of development and implementation of a mediated teaching module (PROJECT). This required application of appropriate aspects of the first three variables. A more detailed task analysis indicated the first three requirements were relatively independent.

Results

A stepwise regression analysis, using the .50 significance level as the entry criterion, was conducted for each of the variables (see Table 2). For the SKILLS variable, field independence emerged as the strongest predictor, with qualitative esthetics as an understandable secondary predictor. The negative relationship of qualitative code histrionics to performance was probably due to the very

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Insert Table 2 about here

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specific criteria used to evaluate the graphics projects. Students were aware of these ahead of time and worked to achieve prespecified levels of performance. These independent variables accounted for over one fourth of the variance in skills scores.

The FINAL variable produced some strong, albeit confusing predictors. The negative relationship of qualitative code histrionics to exam performance is reasonable considering the factual and purposive nature of this variable. The negative predictive relationship between the qualitative visual mode of perception and exam scores is understandable only in terms of the variety of modes through which information is acquired in such a course; the primary nature of the task is linguistic. Qualitative code proxemics as a strong positive predictor (accounting for over 10% of the variance) would seem artifactual, unless some other trait was actually being measured by this variable. In subsequent factor analysis, the second strongest factor (eigenvalue = 2.75) was dominated by this variable. It was correlated with the auditory, synnoetics, and family variables, support the interpersonal communicative interpretation.

The PRACTICUM variable was predicted by the positive influences of qualitative code auditory, the cultural determinant individual, and the deductive reasoning variable, with negative relationships to the magnitude and appraisal inference variables. These relationships are accurately descriptive of the nature of this task, the integration of information acquired through lectures, applied to a problem solving task requiring reasoned inference, with a deemphasis on categorical modes of thinking. The effects of the predictive variables were stronger than for any of the other dependent variables ($R^2 = .438$).

The PROJECT variable scores were predicted by the positive influences of field independence, individuality, and kinesics, all of which are pertinent to the development and presentation of a lesson. The cultural determinant individuality implied by each presentation is consistent with the negative relationship of ethics or group value orientation. Teaching or presentions before a group are personal statements. Students evidently felt no need to role-play or attempt to meet group expectations, as indicated by the negative b value for histrionics.

In an effort to reduce the number of predictor variables, all thirty-one independent variables were factor analyzed. The factor matrix was rotated to varimax criterion (see Table 3). A total of the factors emerged (eigenvalue 1.0), indicating the lack of independence of all 31 variables. The factor structure tht emerged was similar to

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Insert Table 3 about here

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at generated BY Clark and Sheriff (1977). Factor scores for each individual were calculated. These factor scores were then entered into a stepwise regression analysis, again using the .50 significance level as entry criterion (see Table 4). For each dependent variable, the same factor, with loadings for field independence and deductive reasoning, was entered into the regression equations. For the SKILLS and PROJECT variable, this was the only factor entered. Though intellegence data were unavailable for this study, this factor may be found to be highly correlated with general mental ability. For the FINAL variable, an additional factor,

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Insert Table 4 about here

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lated to psychomotor ability, was entered with a negative b value, indicating a strong negative relationship between psychomotor and final exam performance. For the PRACTICUM variable, one other factor was also entered into the regression equation. An emphasis on spoken language vis a vis written language was found to have a negative predictive relationship to performance on this written exercise. Both of these additional factors were readily understandable in terms of the task requirements of each of the dependent variables.

Discussion

The varied nature of performances measured by this course were predicted by a commensurate variation of cognitive styles.

The overlap in cognitive, perceptual, and affective requirements in those tasks is reflected in the duplication of some independent variables. Students enrolled in this course seemingly did not perceive a need to play a role or perform for others. This is due perhaps to the production orientation of the course, and the individuality implied by that product development. The emphasis on the role of media in communication diverting attention from the role of the individual as performer may also have contributed to this effect. The perceptual implications of field independence seemed more important than the reasoning influences, as it impacted more on perceptually related tasks. However, the distillation of the data through factor analysis appeared to reverse this emphasis. The potential of cognitive styles as predictors of learning performance received considerable support. Unlike other studies, styles accounted for a very substantial proportion of the variance (in most cases, over 40%).

While the preeminence of intellegence as the primary predictor of achievement was not proven by this study, it was suggested by the consistent emergence of a single factor that relates strongly to reasoning and inferential ability. The deductive modality of inference, coupled with field independence, would suggest intellectual ability rather than creativity, both of which could be valuable capabilities in such a course.

It is suggested that a similar study, accounting for mental ability, motivation, prior learning, as well as cognitive style be undertaken to establish relative importance of all of these varables. The use of cognitive styles for instructional design is predicated on establishing aptitude-treatment interactions on specific tasks. This study only indicates the relative importance of cognitive styles as predictors but made no attempt to make hypothetical predictions about how they would relate to types of treatment. Considerable research in this area is still needed to clarify the relationship of instructional, individual and task-related variables.

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TABLE 1

Educational Cognitive Style Variables

SYMBOLS AND THEIR MEANINGS

Theoretical Orientation to Symbols:

1. T(AL) Theoretical Auditory Linguistics. Finding meaning through words you hear.

2. T(AQ) Theoretical Auditory Quantitative. Finding meaning in spoken numerical symbols, relationships, and measurements.

3. T(VL) Theoretical Visual Linguistics. Finding meaning from words you see.

4. T(VQ) Theoretical Visual Quantitative. Finding meaning in numerical symbols, relationships, and measurements you see.

Qualitative Orientation to Symbols:

5. Q(A) Qualitative Auditory. Perceiving meaning through the sense of hearing. A major in this area indicates ability to distinguish between sounds, tones of music, and other purely sonic sensations.

6. Q(O) Qualitative Olfactory. Perceiving meaning through the sense of smell.

7. Q(S) Qualitative Savory. Perceiving meaning by the sense of taste. Chefs should have highly developed qualitative olfactory and savory abilities.

8. Q(T) Qualitative Tactile. Perceiving meaning by the sense of touch, temperature, and pain.

9. Q(V) Qualitative Visual. Perceiving meaning through sight.

10. Q(P) Qualitative Code Proprioceptive or sometimes called the sixth sense, synthesizing or combining a number of associated symbols into a performance of a task; e.g., typewriting, playing a musical instrument.

11. Q(CEM) Qualitative Code Empathetic. Sensitivity to the feelings of others, ability to put yourself in another person's place and see things from his point of view.

12. Q(CES) Qualitative Code Esthetic. Enjoying the beauty of an object or an idea. Beauty in surroundings or a well-turned phrase are appreciated by a person possessing a major strength in this area.

13. Q(CET) Qualitative Code Ethic. Commitment to a set of values, a group of principles, obligations and/or duties. This commitment need not imply morality. Both a priest and a criminal may be committed to a set of values although the "values" may be decidedly different.

14. Q(CH) Qualitative Code Histrionic. Exhibiting a deliberate behavior or "playing a role: to produce some particular effect on other persons. This type of person knows how to fulfill role expectations.

15. Q(CK) Qualitative Code Kinesics. Understanding and communicating by non-linguistic functions such as facial expressions and motions of the body (e.g., smiles and gestures).

16. Q(CKH) Qualitative Code Kinesthetic. Performing motor skills according to a recommended, or acceptable, from (e.g., bowling according to form, or golfing).

17. Q(CP) Qualitative Code Proxemics. Judging the physical and social distance that the other person would permit, between oneself and that other person.

18. Q(CS) Qualitative Code Synnoetics. Personal knowledge of oneself.

19. Q(CT) Qualitative Code Transactional. Maintaining a positive communicative interaction which significantly influences the goals of the persons involved in that interaction (e.g., salesmanship).

20. Q(CTM) Qualitative Code Temporal. Responding or behaving according to time expectations imposed on an activity by members in the role-set associated with that activity.

CULTURAL DETERMINANTS OF THE MEANINGS OF SYMBOLS

21. A Represents Associates. A major degree of influence by friends or persons other than family.

22. F Indicates a major Family influence. The family influence might include immediate family, church or special authority figures.

23. I Stands for Individual. An "I" in the major column indicates significant independence in decision making.

MODALITIES OF INFERENCE

24. M Magnitude. A form of "categorical reasoning" that utilizes classifications or rules as the basis for accepting or rejecting an advanced hypothesis. Persons who need to define things or know the "policy" in order to understand them reflect this modality.

25. D — Difference. This pattern suggests a tendency to reason in terms of one-to-one contrasts or comparisons of selected characteristics or measurements, seeing things in terms of how they "differ." Artists often possess this modality as do creative writers and musicians.

26. R — Relationship. This modality requires that things be seen in terms of how they are alike. People with this modality frequently say, "This is like that."

27. L — Appraisal. The modality of inference employed by an individual who uses all three of the modalities noted above (M, D, and R), giving equal weight to each in his reasoning process. Individuals who employ this modality tend to analyze, question, or in effect, appraise that which is under consideration in the process of drawing a probability conclusion.

28. (K) — Deductive. Indicates deductive reasoning, or the form of logical proof used in geometry or that employed in syllogistic reasoning.

TABLE 2

Summary of Stepwise Regression Analyses

(Significant Independent Variables)

Dependent Variable	Intercept	Independent Variables	b Value	Type II SS	F	R^2
SKILLS	183.41	Field Dependence	+0.37	424.63	7.96**	
		Qualitative Code: Esthetic	+0.66	327.80	6.15*	
		Qualitative Code: Histrionic	-0.53	421.96	7.91**	.277
FINAL	83.49	Qualitative Visual	-0.94	790.73	15.96***	
		Qualitative Code: Histrionic	-0.37	209.75	4.23*	
		Qualitative Code: Proxemics	+1.25	924.03	18.65***	.403
PRACTICUM	90.49	Qualitative Auditory	+0.69	469.66	10.34**	
		Individual	+0.70	306.76	6.75*	
		Magnitude	-1.55	1326.38	29.20***	
		Appraisal	-0.42	148.87	3.28	
		Deductive	+0.45	220.99	4.87*	.438
PROJECT	97.07	Field Dependence	+0.31	281.86	6.44*	
		Qualitative Code: Ethic	-0.62	288.53	6.59*	
		Qualitative Code: Histrionic	-0.61	483.57	11.04**	
		Qualitative Code: Kinesics	+0.49	214.44	4.90*	
		Individual	+0.82	428.36	9.78**	
		Magnitude	-0.64	210.96	4.82*	.431

* $p \leq .05$

** $p \leq .01$

*** $p < .001$

TABLE 3

Varinax Rotated Factor Pattern

Variable	Loading
FACTOR 1 (Reasoning)	
Difference	.725
Relationship	.706
Appraisal	.826
Deductive	.510
FACTOR 2 (Interpersonal Communication)	
Auditory	.592
Proxemics	.791
Synnoetics	.509
Family	.593
FACTOR 3 (Spoken Language)	
Auditory Linguistics	.810
Visual Linguistics	-.794
FACTOR 4 (Psychomotor Performance)	
Proprioceptive	.771
Kinesthetic	.847
Histrionic	.463
FACTOR 5 (Persuasiveness)	
Synnoetics	.622
Transactional	.563
Associate	-.695
Individual	.604
FACTOR 6 (Symbolism)	
Visual Quantitative	.863
Histrionics	-.460
FACTOR 7 (Self-Control)	
Locus of Control	.612
Temporal	.813
FACTOR 8 (Visual/Haptic Style)	
Tactile	.751
Visual	.453
Empathetic	-.471
FACTOR 9 (Inference)	
Field Dependence	.834
Deductive	.519
FACTOR 10 (Attendance to Nonverbal Cues)	
Kinesics	.883
Synnoetic	.435
Magnitude	.471

TABLE 4

Stepwise Regression Analysis of Factors

Dependent Variable	Intercept	Factors Retained	b Value	Type II SS	F	R^2
SKILLS	198.31	Factor 9	+1.89	199.54	2.98	.055
FINAL	87.92	Factor 4	-2.98	468.65	8.31**	
		Factor 9	+2.30	269.24	4.78*	.239
PRACTICUM	83.80	Factor 3	-2.14	245.11	3.71	
		Factor 9	+2.03	231.06	3.50	.132
PROJECT	86.39	Factor 9	+2.26	272.82	4.25*	.077

* $p \leq .05$

** $p \leq .01$